

## CLAIMS

1. A method of time tracking in a wireless receiver comprising the steps  
2 of:  
demodulating a first instance of a signal to produce a first set of energy  
4 values corresponding to a set of possible data values of said signal;  
demodulating a second instance of said signal to produce a second set of  
6 energy values corresponding to said set of possible data values;  
combining said first and said second sets of energy values to determine a  
8 combined set of energy values;  
determining a first estimate of a most likely transmitted data value based  
10 upon said combined set of energy values;  
discovering an early set of despread samples of said first instance using a  
12 symbol corresponding to said first estimate to produce a first early energy value;  
discovering a late set of despread samples of said first instance using said  
14 symbol corresponding to said first estimate to produce a first late energy value; and  
determining a time offset of said first instance based upon said first early and  
16 said first late energy values.
2. The method of Claim 1, further comprising the steps of:  
2 discovering an early set of despread samples of said second instance using  
said symbol corresponding to said first estimate to produce a second early energy  
4 value;  
discovering a late set of despread samples of said second instance using said  
6 symbol corresponding to said first estimate to produce a second late energy value;  
and  
8 determining a time offset of said second instance based upon said second  
early and said second late energy values.
3. The method of Claim 1, wherein said second instance arrives at said  
2 receiver before said first instance, and wherein the method further comprises the  
steps of:

4 determining a second estimate of said most likely transmitted data value  
based upon said second set of energy values;

6 discovering an early set of despread samples of said second instance using  
said symbol corresponding to said second estimate to produce a second early energy  
8 value;

10 discovering a late set of despread samples of said second instance using a  
symbol corresponding to said second estimate to produce a second late energy value;  
and

12 determining a time offset of said second instance based upon said second  
early and said second late energy values.

4. The method of Claim 1, further comprising the steps of:

2 demodulating a third instance of a signal to produce a third set of energy  
values corresponding to said set of possible data values;

4 combining said third and said combined set of energy values to determine a  
second combined set of energy values;

6 determining a second estimate of said most likely transmitted data value  
based upon said second combined set of energy values;

8 discovering an early set of despread samples of said third instance using a  
symbol corresponding to said second estimate to produce a third early energy value;

10 discovering a late set of despread samples of said third instance using said  
symbol corresponding to said second estimate to produce a third late energy value;

12 and

14 determining a time offset of said third instance based upon said third early  
and said third late energy values.

5. The method of Claim 1, further comprising the steps of:

2 demodulating a third instance of a signal to produce a third set of energy  
values corresponding to said set of possible data values;

4 wherein said step of combining further comprises the step of combining said  
third set of energy values with said first and second sets of energy values to produce  
6 said combined set of energy values;

8        discovering an early set of despread samples of said third instance using said  
symbol corresponding to said first estimate to produce a third early energy value;

10        discovering a late set of despread samples of said third instance using said  
symbol corresponding to said first estimate to produce a third late energy value; and

12        determining a time offset of said third instance based upon said third early  
and said third late energy values.

6.        An apparatus for time tracking in a wireless receiver comprising:

2        means for demodulating a first instance of a signal to produce a first set of  
energy values corresponding to a set of possible data values of said signal;

4        means for demodulating a second instance of said signal to produce a second  
set of energy values corresponding to said set of possible data values;

6        means for combining said first and said second sets of energy values to  
determine a combined set of energy values;

8        means for determining a first estimate of a most likely transmitted data value  
based upon said combined set of energy values;

10        means for discovering an early set of despread samples of said first instance  
using a symbol corresponding to said first estimate to produce a first early energy  
12        value;

14        means for discovering a late set of despread samples of said first instance  
using said symbol corresponding to said first estimate to produce a first late energy  
value; and

16        means for time tracking said first instance using said first early and said first  
late energy values.

7.        The apparatus of Claim 6, further comprising:

2        means for discovering an early set of despread samples of said second  
instance using said symbol corresponding to said first estimate to produce a second  
4        early energy value;

6        means for discovering a late set of despread samples of said second instance  
using said symbol corresponding to said first estimate to produce a second late  
energy value; and

8 means for time tracking said second instance using said second early and said  
second late energy values.

8. The apparatus of Claim 6, wherein said second instance arrives before  
said first instance, and wherein the apparatus further comprises:

means for determining a second estimate of said most likely transmitted data  
value based upon said second set of energy values;

means for discovering an early set of despread samples of said second  
instance using a symbol corresponding to said second estimate to produce a second  
early energy value;

means for discovering a late set of despread samples of said second instance  
using said symbol corresponding to said second estimate to produce a second late  
energy value; and

means for time tracking said second instance using said second early and said  
second late energy values.

9. The apparatus of Claim 6, further comprising:

means for demodulating a third instance of a signal to produce a third set of  
energy values corresponding to said set of possible data values;

means for combining said third and said combined set of energy values to  
determine a second combined set of energy values;

means for determining a second estimate of said most likely transmitted data  
value based upon said second combined set of energy values;

means for discovering an early set of despread samples of said third instance  
using a symbol corresponding to said second estimate to produce a third early energy  
value;

means for discovering a late set of despread samples of said third instance  
using said symbol corresponding to said second estimate to produce a third late  
energy value; and

means for time tracking said third instance using said third early and said  
third late energy values.

10. The apparatus of Claim 6, further comprising:

2 means for demodulating a third instance of a signal to produce a third set of  
energy values corresponding to said set of possible data values;

4 wherein said means for combining further comprises means for combining  
said third set of energy values with said first and second sets of energy values to  
6 produce said combined set of energy values;

means for discovering an early set of despread samples of said third instance  
8 using said symbol corresponding to said first estimate to produce a third early energy  
value;

10 means for discovering a late set of despread samples of said third instance  
using said symbol corresponding to said first estimate to produce a third late energy  
12 value; and

means for time tracking said third instance using said third early and said  
14 third late energy values.

11. A rake receiver comprising:

2 a first demodulation element configured to receive a series of signal samples  
and configured to be assigned to a first instance of a signal, so as to produce a first  
4 set of energy values corresponding to a set of possible data values of said signal;

a second demodulation element configured to receive said series of signal  
6 samples and configured to be assigned to a second instance of said signal, so as to  
produce a second set of energy values corresponding to said set of possible data  
8 values of said signal;

a combiner configured to combine said first and second sets of energy values  
10 so as to produce a combined set of energy values;

a maximum detector configured to determine a first estimate of a most likely  
12 transmitted data value based upon said combined set of energy values;

a first early symbol discoveror configured to receive a first early set of  
14 despread samples of said first instance, and to discover said first early set of despread  
samples using a symbol corresponding to said first estimate so as to produce a first  
16 early energy value;

a first late symbol discoveror configured to receive a first late set of despread  
18 samples of said first instance, and to discover said first late set of despread samples

20 using a symbol corresponding to said first estimate so as to produce a first late energy value; and

22 a first time trackor configured to receive said first early and said first late energy values so as to produce an updated estimate of a time offset at which said first instance is received.

12. The rake receiver of Claim 11, further comprising:

2 a second early symbol discoveror configured to receive a second early set of despread samples of said second instance, and to discover said second early set of  
4 despread samples using said symbol corresponding to said first estimate so as to produce a second early energy value;

6 a second late symbol discoveror configured to receive a second late set of despread samples of said second instance, and to discover said second late set of  
8 despread samples using said symbol corresponding to said first estimate so as to produce a second late energy value; and

10 a second time trackor configured to receive said second early and said second late energy values so as to produce an updated estimate of a time offset at which said  
12 second instance is received.

13. The rake receiver of Claim 11, wherein said second instance is an earlier arriving signal than said first instance further comprising:

2 a maximum detector configured to determine a second estimate of said most likely transmitted data value based upon said second set of energy values;

4 a second early symbol discoveror configured to receive a second early set of despread samples of said second instance, and to discover said second early set of  
6 despread samples using a symbol corresponding to said second estimate so as to produce a second early energy value;

8 a second late symbol discoveror configured to receive a second late set of despread samples of said second instance, and to discover said second late set of  
10 despread samples using said symbol corresponding to said second estimate so as to produce a second late energy value; and  
12

a second time trackor configured to receive said second early and said second late energy values so as to produce an updated estimate of a time offset at which said second instance is received.

14. The rake receiver of Claim 11, further comprising:

a third demodulation element configured to receive said series of signal samples and configured to be assigned to a third instance of said signal, so as to produce a third set of energy values corresponding to said set of possible data values of said signal;

wherein said combiner is further configured to combine said third set of energy values with said first and second sets of energy values to produce said combined set of energy values;

a third early symbol decoder configured to receive a third early set of despread samples of said third instance, and to decode said third early set of despread samples using said symbol corresponding to said first estimate so as to produce a third early energy value;

a third late symbol decoder configured to receive a third late set of despread samples of said third instance, and to decode said third late set of despread samples using said symbol corresponding to said first estimate so as to produce a third late energy value; and

a third time trackor configured to receive said third early and said third late energy values so as to produce an updated estimate of a time offset at which said third instance is received.

15. The rake receiver of Claim 11, further comprising:

a third demodulation element configured to receive said series of signal samples and configured to be assigned to a third instance of said signal, so as to produce a third set of energy values corresponding to said set of possible data values of said signal;

a second combiner configured to combine said third set of energy values with said combined set of energy values to produce a second combined set of energy values;

10 a second maximum detector configured to determine a second estimate of  
said most likely transmitted data value based upon said second combined set of  
energy values;

12 a third early symbol decoder configured to receive a third early set of  
despread samples of said third instance, and to decode said third early set of  
14 despread samples using a symbol corresponding to said second estimate so as to  
produce a third early energy value;

16 a third late symbol decoder configured to receive a third late set of  
despread samples of said third instance, and to decode said third late set of despread  
18 samples using said symbol corresponding to said second estimate so as to produce a  
third late energy value; and

20 a third time tracker configured to receive said third early and said late early  
energy values so as to produce an updated estimate of a time offset at which said  
22 ~~third instance is received.~~

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